Fisheries and Oceans Science | Pêches et Océans Sciences

CSAS | **SCÉS**

Canadian Stock Assessment Secretariat | **Secrétariat canadien pour l'évaluation des stocks**

Research Document 2000/008 | **Document de recherche 2000/008**

Not to be cited without permission of the authors [1] | Ne pas citer sans autorisation des auteurs [1]

Assessments of Atlantic salmon stocks in selected rivers of Cape Breton Island, 1999

by

T.L. Marshall[1], P.H. LeBlanc[1], K.A. Rutherford[1], and R.A. Jones[2]

Department of Fisheries and Oceans
Science Branch, Maritimes Region
[1]P.O. Box 1006, Dartmouth, NS B2Y 4A2
[2]P.O. Box 5030, Moncton, NB E1C 9B6

[1] This series documents the scientific basis for the evaluation of fisheries resources in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

[1] La présente série documente les bases scientifiques des évaluations des ressources halieutiques du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

Research documents are produced in the official language in which they are provided to the Secretariat.

Les documents de recherche sont publiés dans la langue officielle utilisée dans le manuscrit envoyé au Secrétariat.

This document is available on the Internet at: http://www.dfo-mpo.gc.ca/csas/

Ce document est disponible sur l'Internet à:

ISSN 1480-4883
Ottawa, 2000

Canada

Abstract

Assessments of the stock status of Atlantic salmon were conducted on the Margaree, Middle, Baddeck, North, and Grand rivers of SFAs 18 and 19, Cape Breton Island. These rivers account for 90+% of the total recreational fishing effort exerted on the Island's 22 rivers reportedly fished for salmon in 1999. Juvenile salmon abundance was also assessed on the Sydney, Tillard, Skye, Cheticamp, Inhabitants, Gaspereaux, and Mabou rivers.

Conservation requirements in 1999 continue to have been met and are expected to be exceeded in 2000 on the Margaree and probably other West Coast Cape Breton rivers. Conservation requirements have generally not been achieved in recent years on the Middle and Baddeck rivers and perhaps other tributaries of Bras d'Or Lakes. Expectations are that returns to rivers of Bras d'Or will not meet requirements in 2000. North River conservation requirements may have been met in 1999, and, based on the five-year mean, there is an 88% probability that returns in 2000 will be sufficient to meet conservation requirements. Returns to the Grand River fishway in 1999 met less than one-half the conservation requirement for the area upriver of the fishway and there is a <1% probability that conservation requirements will be met in 2000.

Densities of fry and parr for most stocks of Gulf Cape Breton and Bras d'Or Lakes rivers (excepting Skye) suggest that these stocks are meeting or exceeding egg conservation requirements. Juvenile densities in Atlantic coast rivers are relatively low.

Comparison of now similarly derived conservation requirements for the Margaree, Middle, Baddeck and North rivers does not adequately resolve the inconsistencies between estimated escapements and resultant juvenile densities.

Résumé

L'état des stocks de saumons de l'Atlantique a été évalué dans les rivières Margaree, Middle, Baddeck, North et Grand des ZPS 18 et 19, sur l'île du Cap-Breton. Ces rivières ont fait l'objet de plus de 90 % de tout l'effort de pêche récréative exercé sur les 22 rivières de l'île où on a pratiqué la pêche du saumon en 1999. L'abondance des saumons juvéniles a également été évaluée dans les rivières Sydney, Tillard, Skye, Chéticamp, Inhabitants, Gaspereaux et Mabou.

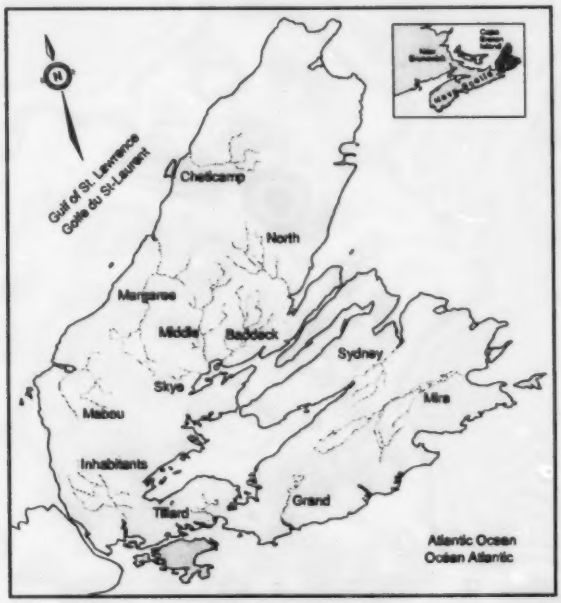
Dans la Margaree et sans doute dans d'autres rivières de la côte Ouest de l'île du Cap-Breton, les impératifs de conservation ont encore été atteints en 1999 et ils devraient être dépassés en 2000. Depuis quelques années, les impératifs de conservation n'ont généralement pas été atteints dans les rivières Middle et Baddeck, et peut-être aussi dans d'autres tributaires des lacs Bras d'Or. On s'attend à ce que les remontes dans les tributaires des lacs Bras d'Or n'atteignent pas les impératifs en 2000. Les impératifs de conservation pourraient avoir été atteints dans la rivière North en 1999 ; la moyenne quinquennale indique qu'il y a une probabilité de 88% que la remonte de 2000 soit suffisante pour atteindre les impératifs de conservation dans cette rivière. En 1999, la remonte jusqu'à la passe migratoire de la rivière Grand a représenté moins de la moitié de l'impératif de conservation pour le secteur en amont de la passe ; la probabilité que cet impératif soit atteint en 2000 est inférieure à 1%.

Les densités d'alevins et de tacons de la plupart des stocks des rivières de l'île du Cap-Breton dans les lacs Bras d'Or (à l'exception de la rivière Skye) portent à croire que la ponte atteint ou dépasse les impératifs de conservation pour ces stocks. Les densités de juvéniles sont relativement faibles dans les rivières de la côte atlantique.

La comparaison des impératifs de conservation maintenant déterminés de façon semblable pour les rivières Margaree, Middle, Baddeck et North ne permet pas de bien expliquer les discordances entre les échappées estimées et les densités de juvéniles qui en résultent.

Introduction

Salmon stocks of Cape Breton Island (SFAs 19 and part 18) include those which typically exceed conservation requirements (Margaree and North), fluctuate about requirements (Grand River; with hatchery assistance) and fall short of requirements (Middle and Baddeck rivers). With minor exceptions, recent management strategies for SFA 18 (Cape Breton) have permitted a recreational fishery with retention of 1SW (small) salmon and hook-and-release of MSW fish (large salmon). An Aboriginal food fishery for 130 small and 650 large salmon is permitted for the Margaree. In SFA 19, recreational fisheries have generally been limited to hook-and-release grilse (occasional closure) and in 1999 a modest Aboriginal food fishery for 50 small and 50 large salmon from the North River.



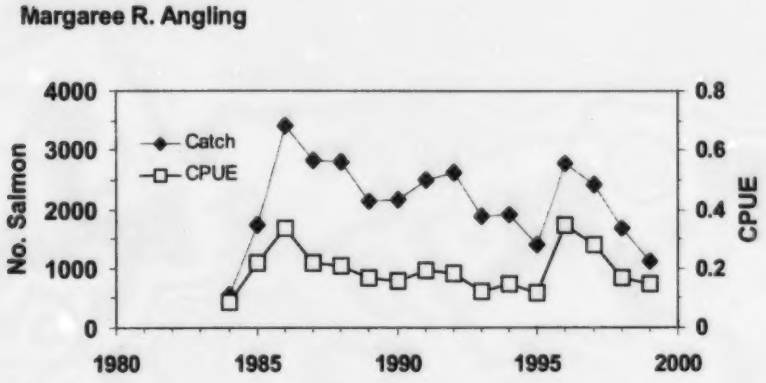
Margaree River

Fishery

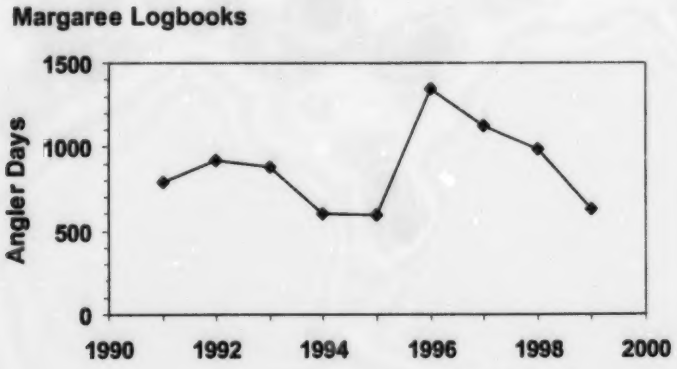
In 1999, 130 small and 650 large salmon were allocated to five First Nations. A total of 30 small and 150 large fish were allocated to the period June 1-August 31, the remainder were to be taken September 1- October 31, except where extensions were granted for seining in November and December. Harvest records solicited from three First Nations totalled only 8 small and 45 large salmon (Table 1) taken mostly by river seining.

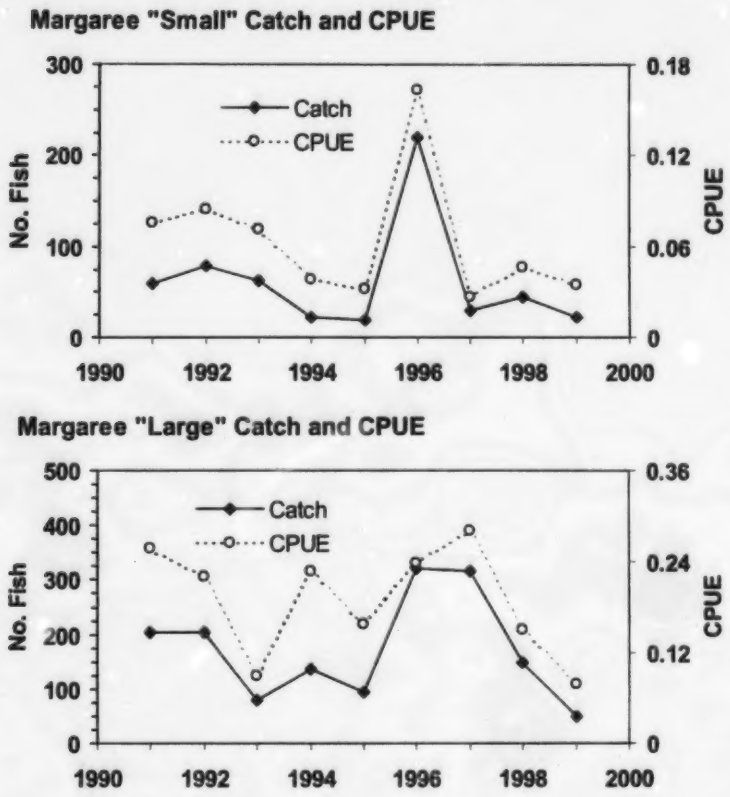
Regulations for the recreational fishery in 1999 were identical to those of 1997 and 1998, retention of small salmon and hook-and-release of large salmon, June 1- October 31 (Appendix 1). Interim estimates of catch from voluntary returns of the Nova Scotia

Salmon License stubs (data resulting from reminder letters was unavailable at time of writing) suggest a retention of 246 small salmon and release of 130 small and 927 large salmon (Appendix II). Based on the difference between December interim and spring "final" estimates in 1998, the final estimate for 1999 could drop to about 800 large salmon. The current estimate of total catch in 1999 is the lowest since 1984, 78% of that of 1998 and 48% of the most recent high in 1996. The relatively higher catch-per-unit effort values since 1995 are consistent with a reduction in angling effort thereafter (Appendix III).



The low salmon catch estimated from voluntary licence stub return data is consistent with more detailed data provided by anglers who kept a daily log of their activities and catch on the Margaree (Appendix V).





Removals (Table 1) include an assumed 5% hook-and-release induced mortality. Thirty-seven summer-run fish were collected for broodstock by the Aquatic Development Association of Margaree (ADAM) and yielded 184,000 eggs for incubation and release back to the river as age-0^+ fry.

Status

Habitat

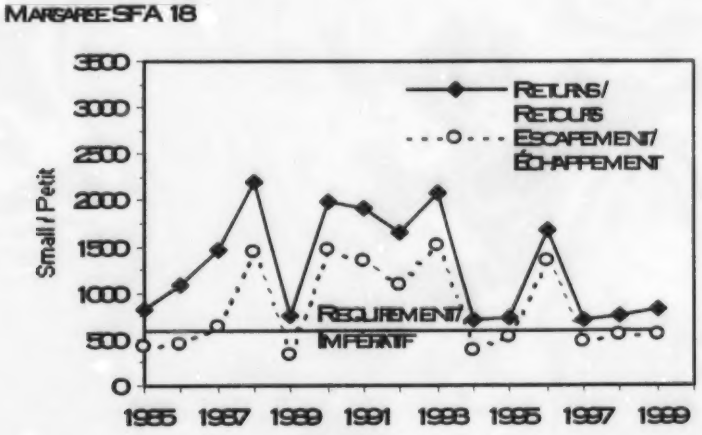
The Margaree River, like the Middle, Baddeck and North rivers which originate in the Cape Breton Highlands of Inverness and Victoria counties, is unobstructed, unimpacted by acid precipitation and only modestly exposed to agricultural practices in the lower valley. Flow regimes have changed within the Margaree drainage. Pol (MS1975) indicated that for the period 1967-1973, there had been an increase in the frequency and magnitude of peak flows and lower and more frequent low flows than in preceding years. Causative agents were not fully identified by Pol (*op. cit.*; there had been a 10% increase in rainfall over the period) but flood frequency and magnitude could have been enhanced by the mortality and harvesting of much of the Highland's forests as a result of a spruce budworm infestation.

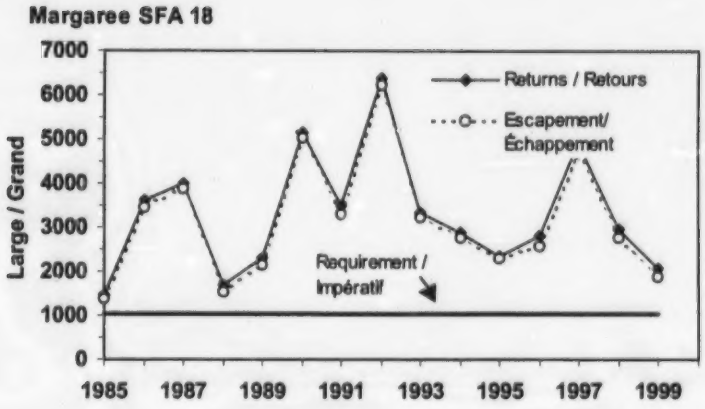
The Margaree River is not affected by the aquaculture industry. ADAM released 99,476 (35% marked) age-0^+ juveniles back to the river in 1999. A private hatchery rearing trout for private catch-out is believed to be the source of the occasional large adult rainbow trout (*Oncorhynchus mykiss*) observed in the recreational catch and past assessment operations. Bacterial kidney disease (*Renibacterium salmonarium*) is ubiquitous within the drainage (Paterson *et al.* 1979) and although known to cause post-winter mortality in the hatchery located on the Northeast Margaree, the disease has not been demonstrated to cause mortalities among juvenile salmon in the wild.

Stock

Returns of large salmon to the Margaree were estimated from preliminary estimates of recreational catch (Nova Scotia License stub returns) and catch rates 1991-1996 (Marshall *et al.* MS 1998). Catch rates are the product of catch from NS License stub returns and the reciprocal of mark-and-recapture based estimates of adult returns when DFO operated Levi's trapnet in the Margaree estuary. For small salmon, the estimate is based on a significant regression between catch and estimated returns, 1991-1996 (Marshall *et al.* MS1998).

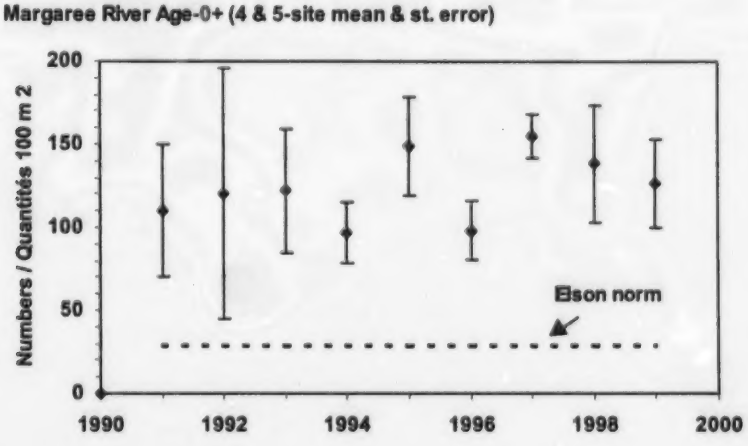
Interim catch estimates of 376 small and 927 large salmon on the Margaree in 1999 contribute to interim estimates of 820 (90% CL 20-1,614) small and 2,060 (90% CL 1,444-2,402) large salmon returning to the Margaree. Small salmon returns are similar to those of four of the last five years. Large salmon were down 30% from 1998 and are the lowest estimate since 1988. After deduction of removals and losses to hook-and-release mortality, interim escapements number 550 small and 1,901 large salmon.

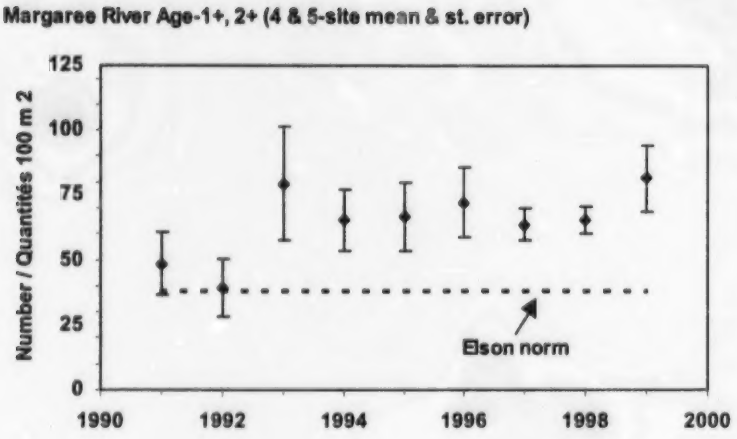




The conservation requirements for the Margaree River are based on an egg deposition of 2.4 eggs per m^2, historical biological characteristics and 2.798 million m^2 of habitat. Required fish to provide those eggs are 1,036 large salmon and for sufficient males, 582 small salmon although current biological data (Marshall *et al.* MS 1999b) suggests that 1,250 large and 660 small would be more appropriate. In 1999, small salmon escapement was about 95% of traditional requirement, large salmon were about 185% of traditional requirement. Total egg requirements have been exceeded in every year since 1985.

Mean juvenile densities for a site on each of Forest Glen, MacFarlanes and Big brooks in 1999 were 132 age-0^+ per 100 m^2 and 90 age-1^+ and -2^+ parr per 100 m^2 and are 4.6 and 2.5 times the Elson (1967) norm of 29 fry and 38 parr per 100 m^2. Monitoring at the same sites since 1992 (below), and also at a large mainstem site reveals densities consistently above the norms and consistent with escapements of two to six times the conservation requirements since 1991.





Outlook

Past forecasts of large returns to the Margaree have been derived from stock-recruit relationships, 1947- to present, using tabular, Ricker, Beverton-Holt and "mean" models (Marshall *et al.* MS 1998). Never in the 40 years of data have recruits been estimated to be less than conservation requirements. The prognoses for returns in the year 2000, based on the mean of the last five-years, is about 3,000 (90% CL 1,200-4,860) MSW fish. Based on the mean, there is a greater than 96% probability (Bayes procedures) that traditional conservation requirements will be met. Prognoses of small salmon returns have typically been presented as the mean of the previous five years. On this basis, forecast returns are about 950 (90% CL 300-1,630) fish and the probability of meeting the 582 fish conservation requirements is about 80%.

Fisheries Management Considerations

Conservation requirements continued to have been met and are expected to be exceeded in 2000 on the Margaree and probably other east coast Cape Breton rivers (see 'Other Rivers of SFA 18 and 19). Small salmon are predominantly male, usually are less abundant than large salmon, and generally are not constraining to stock conservation.

Exploitation levels, both realized (harvests by Aboriginal peoples have rarely exceeded 25% of allocation) and potential on the Margaree River have not, to date, been a conservation concern.

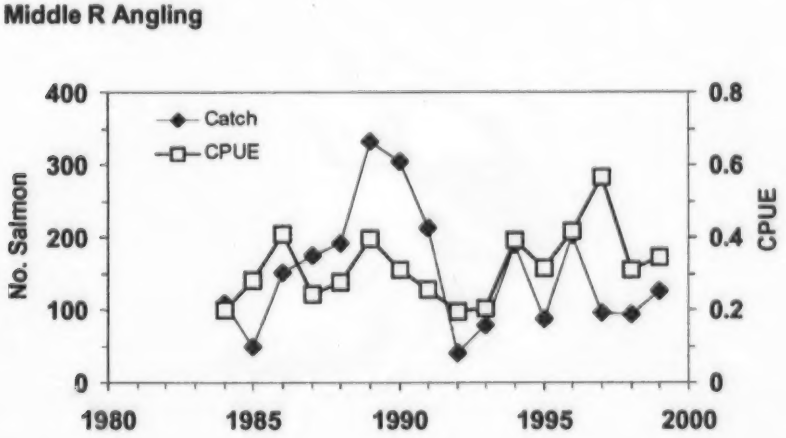
Middle River

Fishery

In 1999, there was a total allocation of 100 small salmon from Middle River, Nyanza Bay and Bras d'Or Lakes to Wagmatcook First Nation. Fishing was to commence once conservation requirements had been met on the Middle River, i.e., following mid-/late fall assessment of returns; a harvest of only five small and nine large salmon was

reported. Gillnetting was actively discouraged by Aboriginal guardians prior to the fall assessment of returns. However, an active rod-and-line winter fishery for kelts (fish which spawned in the fall of 1998) was again acknowledged. This "opportunistic" fishery was the result of a mild winter with open-ice periods, and apparently flourished under similar conditions the previous winter.

The hook-and-release (small and large salmon) recreational fishery for the Middle and other rivers of SFA 19 was reduced from the June 1-October 31 season in 1997, to that of June 1-July 15 and September 1-October 31 in 1998 and 1999. The split season was implemented after consultation with Cape Breton First Nations who sought to reduce the risk of hook-and-release mortality on returns which, with few exceptions, were forecast pre-season to be less than conservation requirements. The reduced season should have had little impact on the overall recreational effort and therefore hook-and-release mortality on the Middle River. Estimates of catch from voluntary returns of the Nova Scotia Salmon License stub were 40 small and 134 large salmon, both values exceeding those of 1998 (Appendix II). Total angled salmon were about double those of 1998 and only slightly fewer than two of the last eight years.



Removals (Table 1) include an assumed 5% hook-and-release induced mortality prior to 1998 and 3% in 1998 and 1999.

Status

Habitat

The Middle River, like the Margaree, Baddeck and North rivers which originate in the Cape Breton Highlands of Inverness and Victoria counties, is unobstructed, unimpacted by acid precipitation but exposed to agricultural practices in the lower valley. Possible changes in flow regimes from the Highlands were mentioned for the Margaree River. The

course of the lower Middle River appears to have shifted more dramatically than other assessed rivers of Cape Breton.

The Middle River has on occasion had small numbers of farmed escapees coincident with reported escapes from industry grow-out sites in Bras d'Or Lakes, i.e., from Whycocomagh Bay to Seal Island. Occasional adult rainbow trout are observed and sometimes reported. Juvenile rainbow trout are rare among juvenile salmon when assessed by electrofishing. Bacterial kidney disease has also been reported from Middle River (Paterson *et al.* 1979). There is currently no stocking of hatchery-reared salmon.

Stock

Returns of salmon to the Middle River were derived using mark-and-recapture methods and Bayes estimation procedures (Marshall *et al.* MS1998) even though no marks were applied in 1999. Counts of unmarked fish were obtained by divers floating virtually all of the river's salmon holding areas on October 18 and all except the upper most reach again on November 3. The October 18 count occurred on the only day of the "traditional" assessment week of (~ October 18-23) on which there was low enough river discharge and adequate visibility. The November 3 repeat followed reports of "new" fish in the previously near-vacant lower sections of the river.

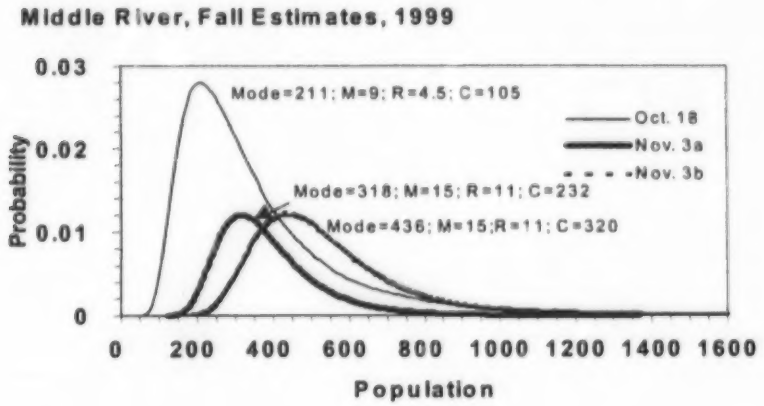
On October 18 the count was conducted in the traditional sections downstream of Highway #19, as well as 5 pools at and below Second Gold Brook. An additional 9-10 km. section was floated from just above Fionnar Brook down to and including the traditional Gold Brook pools. River discharge was higher than any of the previous gauged years (3) and visibility deteriorated later in the day under continuous rain. The count was 105 fish (72 large and 33 small). An additional 12 large and three small were counted in the above-Fionnar to First Gold brooks section but not used in the Oct 18 "traditional area" estimate.

For the purposes of estimating a population, Bayes procedures were used to generate mark-recapture estimates under the assumption that if there had been marked fish within the population, only 0.5, the lowest of record, would have been "recaptured" (seen during the count). The uncertainty of the estimate was captured by assuming (on the basis of counts in seinable pools, and previous seining history at these pools) that only nine fish might have been marked and available for recapture during the float count. By assuming a 0.5 recovery efficiency it followed that 4.5 fish were assumed to have been recaptured in the float count. These hypothetical "mark" and "recapture" data suggest a population estimate for the traditional river area of 211 fish (145 large and 66 small) and a 15% probability that conservation requirements of 550 salmon may have been met (see Figure below).

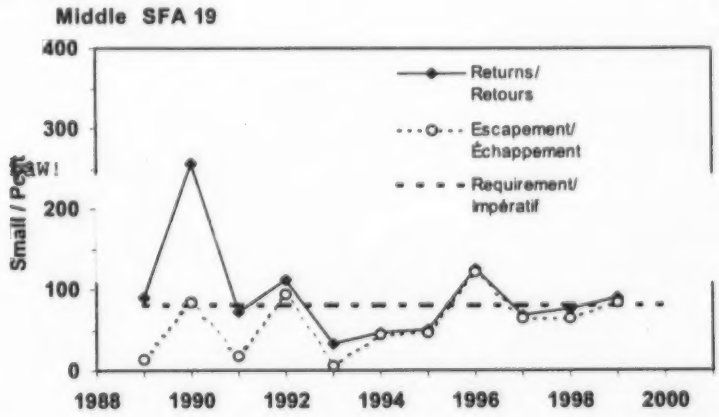
On November 3 the count was repeated in only the traditional census areas. Float conditions were excellent, i.e., river discharge was less than October 18 and visibility was excellent. The count was 232 fish (187 large and 45 small); conditions suggested that about 0.75 of the fish would have been seen, i.e., equal to the best previous recovery efficiency to date. It was assumed that about 15 fish had the potential to have been

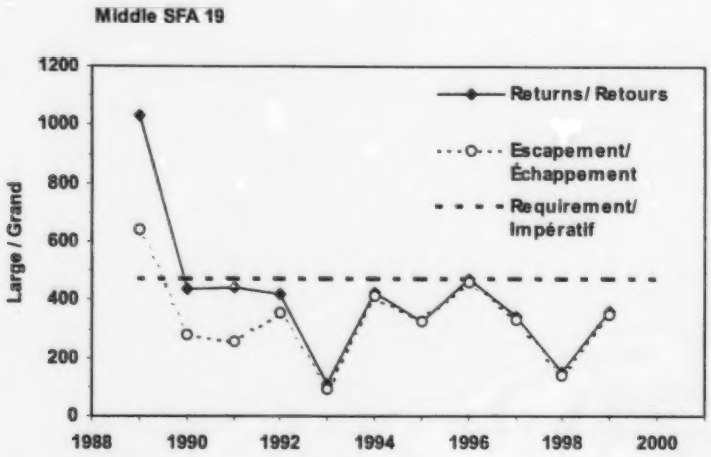
marked prior to this float count, and on the basis of the assumed 0.75 recovery rate, 11 fish would have been recaptured in the float count. These data suggest a total population estimate for the traditional river areas of just over 300 fish (256 large and 62 small) and a 3% chance that conservation requirements may have been met (see Figure).

A second estimate for Nov 3 incorporated fish observed above Second Gold Book on Oct 18, raised by the fraction of fish counted in the five pools downstream of Second Gold Brook Oct 18 and Nov 3, minus the Gold Brooks area count on Nov 3, i.e., [(21/((6/35)-35)] into the "count". This estimate of population is 436 fish (351 large and 85 small; based on count composition) with a 36% chance that conservation requirement was met.



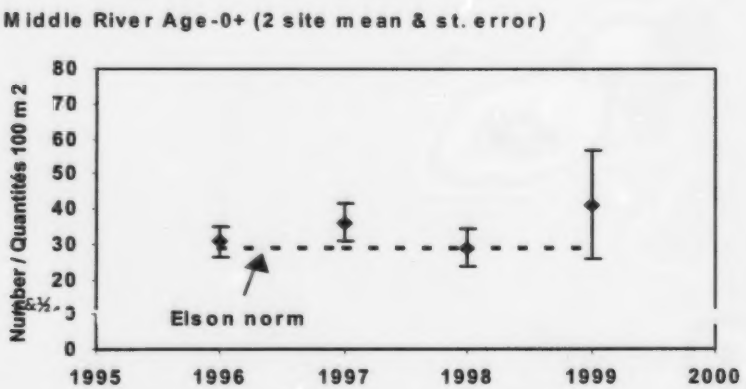
Total returns would number 450 fish and include an estimated 14 fish lost in the estuary. These returns are 198% of those in 1998 (Table 2). The November 3 population is assumed to be the escapement.

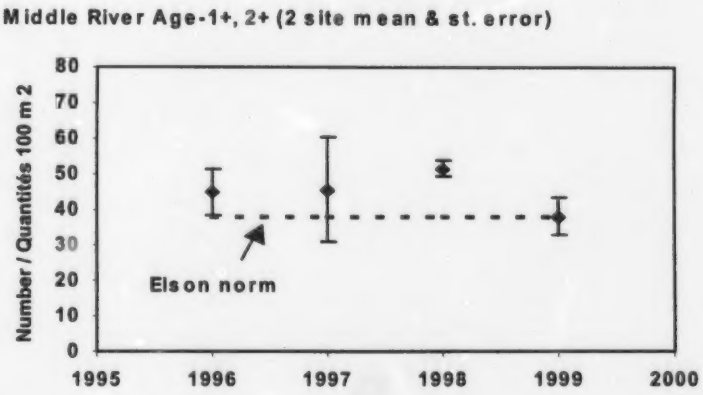




Conservation requirements for the Middle River are 2.07 million eggs from 470 large and 80 small salmon (Marshall *et al.* MS1998) although current biological data (Marshall *et al.* MS 1999b) suggests that 590 large and 140 small would be more appropriate. Assuming that late-season estimates of returns equal escapement, small salmon were about 99% and large salmon were 72% of traditional requirement. In total, the probability that returns equaled traditional conservation requirements was 36% .

Mean juvenile densities of 41 age-0^+ per 100 m^2 and 38 age-1^+ and -2^+ parr per 100 m^2 for two mainstem sites on Middle River in 1999 were 1.4 and 1.0 times the Elson (1967) norm. Monitoring since 1995 indicates densities to be consistently at or slightly above the norms even though escapement for egg requirements are not estimated to have been met.





Outlook

For the Middle River, prognoses of returns were based on the previous five-year returns. The mean of combined small and large returns in the past five years is 414 fish (90% CL 199-629 fish). Based on this mean and standard deviation, the Bayes derived probability of the 1999 return exceeding the 550 fish requirement is 14% (<1% based on recent biological characteristics and egg carrying capacity). It is uncertain if normal or above-normal parr densities on the Middle River will contribute to the near-future attainment of conservation requirements.

Fisheries Management Considerations

Conservation requirements have generally not been achieved in the Middle River and there is only 14% expectation that returns will meet requirements in 2000.

Baddeck River

Fishery

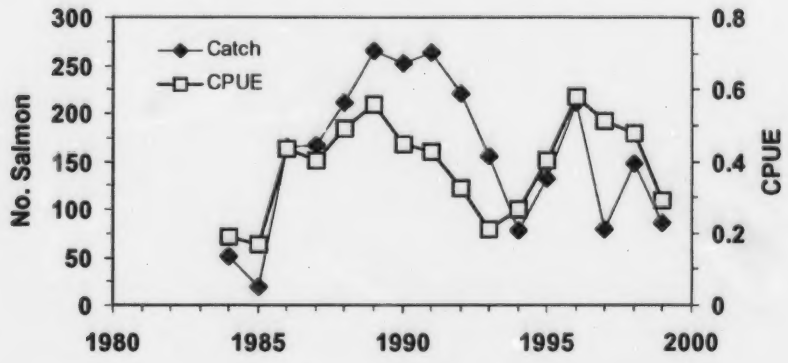
There has been no specific allocation of Baddeck River fish to Aboriginal peoples. However, it is assumed that a gillnet fishery for 100 small salmon from Middle River outflow, Nyanza Bay and Bras d'Or Lakes to Wagmatcook First Nation would impact 30 fish of Baddeck River origin. The impact would only have been after conservation requirements had been met on the Middle River, i.e., following mid/late fall assessment of returns. No harvests have been reported although gillnetting was actively discouraged by Aboriginal guardians prior to the fall assessment of returns to Middle River (Table 1).

The hook-and-release (small and large salmon) recreational fishery for the Baddeck and other rivers of SFA 19 was reduced from June 1-October 31 in 1997, to that of June 1-July 15 and September 1-October 31 in 1998 and 1999. The reduced season should have [illegible] impact on the overall recreational effort on the Baddeck River, given that returns rarely enter the river before fall. Estimates of catch from voluntary returns of the Nova Scotia Salmon Licence stub were 11 small and 81 large salmon; less than those of

â"±âF±t ¼FÞp-

1998 (Appendix II). Catch-per-unit of effort was lower than values since 1995 but does not differ from the long-term mean (Appendix III).

Baddeck R. Angling



Removals (Table 1) include an assumed 5% hook-and-release induced mortality prior to 1998 and 3% in 1998 and 1999.

Status

Habitat

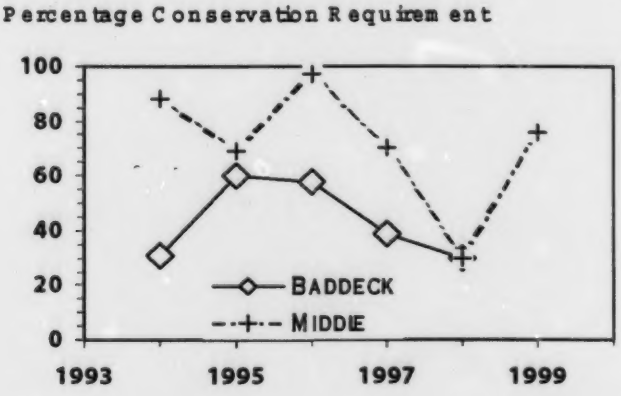
The Baddeck River, like the Margaree, Middle and North rivers which originate in the Cape Breton Highlands of Inverness and Victoria counties, is unobstructed, unimpacted by acid precipitation and only modestly exposed to agricultural practices in the lower valley. Possible changes in flow regimes from the Highlands were mentioned previously.

The Baddeck River has on occasion had small numbers of farmed escapes coincident with reported escapees from industry grow-out sites in Bras d'Or Lakes, i.e., from Whycocomagh Bay to Seal Island. Occasional adult rainbow trout are observed/reported; juvenile rainbows have not been observed among juvenile salmon assessed by electrofishing. Bacterial kidney disease has also been reported from Baddeck River (Paterson *et al.* 1979). There is currently no stocking of hatchery-reared salmon.

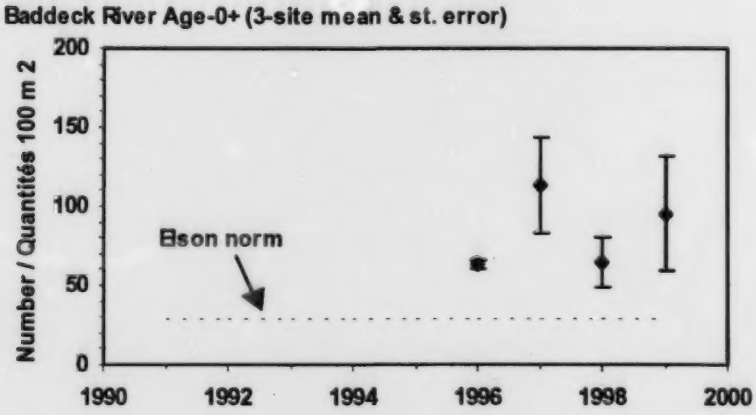
Stock

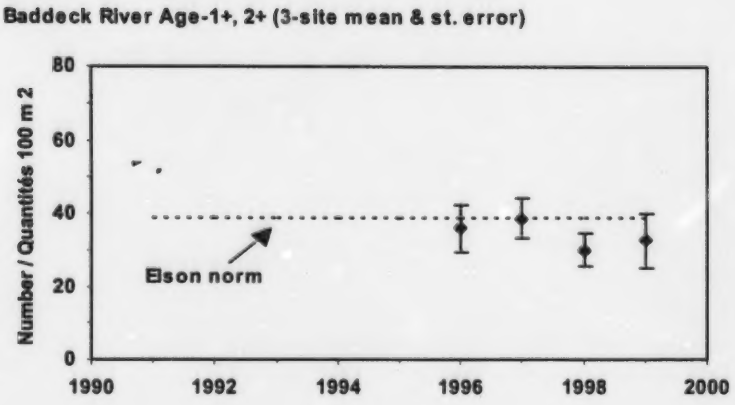
High water conditions during the scheduled fall assessment of adults returns and lack of adequate person resources for any re-scheduled efforts precluded the estimate of returns and escapement to the Baddeck River in 1999. Conservation requirements for the Baddeck River are 2.0 million eggs from 450 large and 80 small salmon (Marshall *et al.* MS1998) although current biological data (Marshall *et al.* MS 1999b) suggests that 390 large and 230 small salmon would be more appropriate. Since adult assessments began on the Baddeck in 1994, conservation requirements have never been estimated to have been met, and the proportion of requirements met by large salmon, the significant contributors

to egg deposition, has always been equal to (1998) or less than that of the Middle River (Marshall *et al.* 1999b). A 13% reduction in the requirement for large salmon would not dramatically alter the picture.



Mean juvenile densities of 95.2 age-0^+ per 100 m^2 and 32.6 age-1^+ and -2^+ parr per 100 m^2 for three mainstem sites on Baddeck River in 1999 were 3.2 and 0.8 times the Elson (1967) norm. Monitoring since 1996 indicates that densities of age-0^+ fluctuate above while densities of age-1^+ and -2^+ parr fluctuate around the Elson norms even though escapement requirements are not estimated to have been met.





Outlook

For the Baddeck River, in 1999, prognoses of returns were based on returns in 1995-1999, assuming that conservation requirements of 530 salmon had been met. The mean return would have been 335 fish (90% CL 131-542 fish). The probability of returns in the year 2000 exceeding the 530 fish conservation requirement would be less than 7%. Parr densities, which are near the Elson (1967) norm, are not necessarily indicative of increasing returns beyond the year 2000.

Fisheries Management Considerations

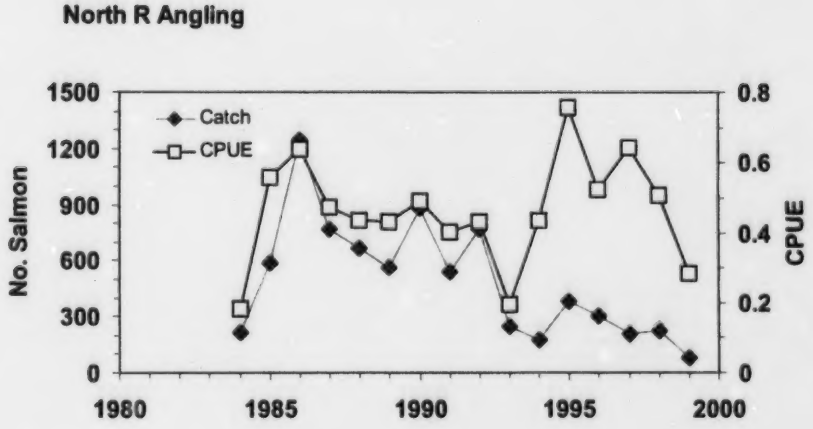
Conservation requirements have not been achieved in the Baddeck River and there is little evidence to suggest that returns will meet requirements in 2000.

North River

Fishery

Ten large and 10 small salmon from the North River were allocated (nets not permitted) to each of the five First Nations on Cape Breton (100 fish total). This was the same as in 1998 but down from the 20 large and 15 small salmon allocated in 1997. No harvests have been reported in 1999 or in the recent past (Table 1).

The hook-and-release (small and large salmon) recreational fishery for the North River, unlike other rivers of SFA 19, remained June 1-October 31. Estimates of catch from voluntary returns of the Nova Scotia Salmon License stub were 29 small and 60 large salmon (Appendix II). The catch is the lowest of the time series; the catch-per-unit of effort is the lowest of the previous five years and third lowest of the time series (Appendix III).



Removals (Table 1) include an assumed 5% hook-and-release induced mortality prior to 1998 and 3% in 1998 and 1999.

Status

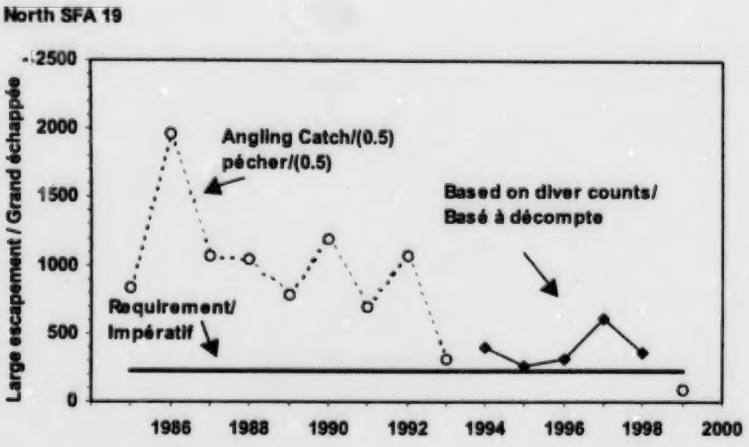
Habitat

The North River, like the Margaree, Middle and Baddeck rivers which originate in the Cape Breton Highlands of Inverness and Victoria counties, is unobstructed and unimpacted by either acid precipitation or agricultural practices in the lower valley. Possible changes in flow regimes from the Highlands were mentioned previously.

The North River has on occasion had small numbers of farmed escapees coincident with reported escapees from industry grow-out sites in Bras d'Or Lakes, especially Seal Island. Occasional adult rainbow trout are observed/reported; juvenile fish have not been observed among juvenile salmon assessed by electrofishing. Bacterial kidney disease has also been reported from North River (Paterson *et al.* 1979). There is currently no stocking of hatchery-reared salmon.

Stock

North River salmon are primarily a 2SW June/July- running stock that in recent years has been suspect of having a "delinquent" component which ascends in the fall (Marshall et al. MS 1996). Previous assessments indicate that conservation requirements 1985-1998, have always been attained.



As was the case on the Baddeck River, high water conditions during the scheduled fall assessment period precluded diver counts of adult returns. An assessment based on the preliminary estimate of sport catch (NS Licence stub returns) and a catch rate of 0.5 (Amiro and Harvie MS 1996) for large salmon, as was done 1985-1993, suggests that river return may have numbered only 120 fish (approximately 60 fish were observed by diving in the two main summer holding pools upriver of the gorge in July). There is no correlation between returns estimated from diver counts and angling ($p=0.62$), 1994-1998. However, diver count-based estimates exceeded angler catch based estimates (average of 50%) in four years out of five and offer the possibility that large salmon returns and escapement approximate conservation requirements of 200 large salmon. Conservation requirements for the North River are 0.85 million eggs from 200 large and 30 small salmon (Marshall *et al.* MS1998) although current biological data (Marshall *et al.* MS 1999b) suggests that 220 large and 160 small would be more appropriate.

Mean juvenile densities of 41.6 age-0^+ per 100 m^2 and 42.1 age-1^+ and -2^+ parr per 100 m^2 for four mainstem sites on North River in 1999 were 1.4 and 1.1 times the Elson (1967) norm (Appendix IV). Monitoring at two of the same sites in 1998 yielded one-third as many age-0^+ per 100 m^2 and two-thirds as many age-1^+ and -2^+ parr per 100 m^2.

Outlook

Stock-and-recruit data have been developed for the North River but recent prognoses relative to the attainment of conservation requirements could just as easily have been based on the mean of recent years. The mean of wild salmon returns in the past five years, even with an escapement of just 120 large fish and 58 (angler catch of 29/0.5) small fish is 476 (90% CL 145-824 fish). The Bayes derived probability of the estimate exceeding the 230 fish requirement in 2000 is greater than 88%. Under the assumption that the 1999 estimate of returns is realistic and in light of the evidence that returns have declined to sub-conservation requirements in the last three years, it would be prudent to heed the values encompassing the lower bounds of the prognoses.

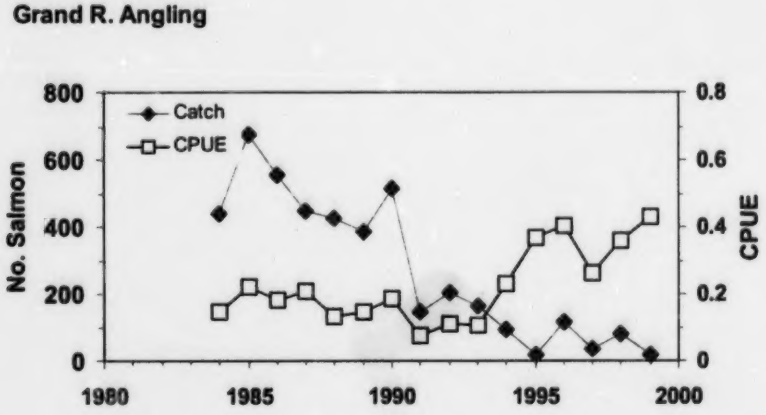
Fisheries Management Considerations

Conservation requirements of North River may not have been met in 1999, but there is an 88% chance that fish conservation requirements will be met in the year 2000. Continued allocation of North River fish to Aboriginals should consider the possibility that the stock is in decline and that there is slightly better than one chance in ten that conservation requirements will not be met.

Grand River

Fishery

There has been no recent allocation of Grand River salmon to First Nations and to date, no reported removals (Table 1). The hook-and-release (all salmon) recreational fishery for the Grand River was also reduced from June 1-October 31 in 1997, to that of June 1-July 15 and September 1-October 31 in 1998 and 1999. Estimates of catch from only four voluntarily returned Nova Scotia Salmon Licence stubs were 25 small and seven large salmon (Appendix II). The estimated catches are the lowest of any year since 1984 (the few fish reported in 1995 were taken during a season closure).



Removals (Table 1) include an assumed 7% hook-and-release induced mortality prior to 1999 (including 1995 when the season was closed) and an assumed 4% without a summer season in 1998 and 1999.

Status

Habitat

Grand River, Richmond County, is a low gradient river in which the mainstem flow and temperature is moderated by headwater lakes, including Monroe, Uist and Loch Lomond. Grand River Falls is an obstruction to salmon at low discharge and is located 10.2 km

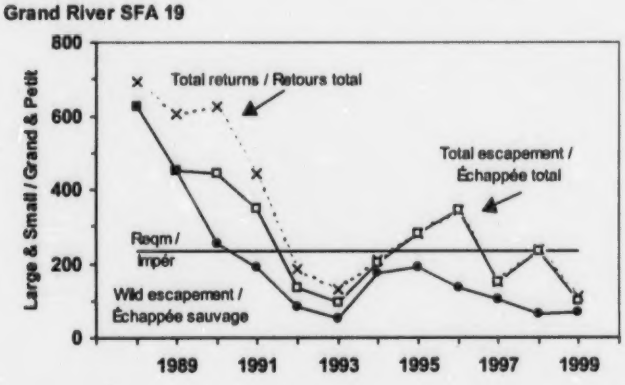
above head-of-tide. A fishway at the Falls is estimated to pass an average 60% of small and 43% of large salmon that approach it (Amiro and Longard MS 1990 and MS 1995). It is estimated that 45% of the juvenile production area is above the falls (Amiro and Longard *op. cit.*).

The Grand River fishway is not known to have passed farmed escapees but the river does support a small population of resident brown trout (*Salmo trutta*). Atlantic salmon stocked in 1996 (23,500 age 0^+ parr) contributed to 33% of small salmon returns in 1999.

Stock

Unlike most other Cape Breton stocks, salmon of the Grand River are principally small (1SW) and of June/July (80%) run timing. The few large salmon are almost all repeat-spawning 1SW fish. Returns have declined in recent years despite significant hatchery supplementation with Grand River stock (Marshall *et al.* MS 1998) and the elimination of south coast Newfoundland commercial fisheries. Partial counts of salmon were made at a trap in a fishway at Grand Falls through August 31, total returns were estimated as [[Count/[1- by-pass rate (0.4)]/0.8 the counted component]].

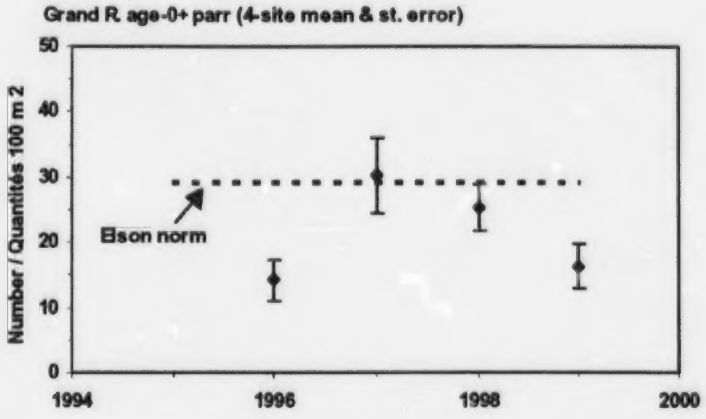
The count of wild and hatchery-origin salmon in 1999 was 42 small and two large fish; the estimate of returns, including an estimated "removal" of nine fish from either the fishway or below, is 101 salmon of which 34% were of hatchery origin. Since 1994, escapements have approximated total returns. Wild escapements in 1999 numbered an estimated 73 fish, the third lowest of the series beginning in 1988.

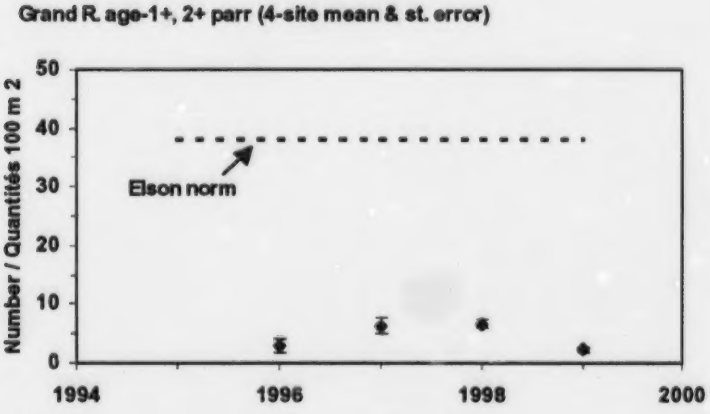


Conservation requirements for the entire Grand River are 1.1 million eggs from 545 salmon (mostly small). Required above the fishway are 234 salmon (475,000 eggs). In 1999, escapement of wild and hatchery salmon above the fishway was 43% of requirement, the second lowest of the 12-year data set. Wild salmon escapement, as in 1998 is again under 30% of requirements.

Juvenile densities at four sites on the main stem (two above and two below the falls) averaged 16.3 age-0^+ and 2.3 age-1^+ and -2^+ parr per 100 m^2, 56% and 6% of respective

norms. The decline in densities is consistent with the estimated decrease in egg depositions since 1996.





Outlook

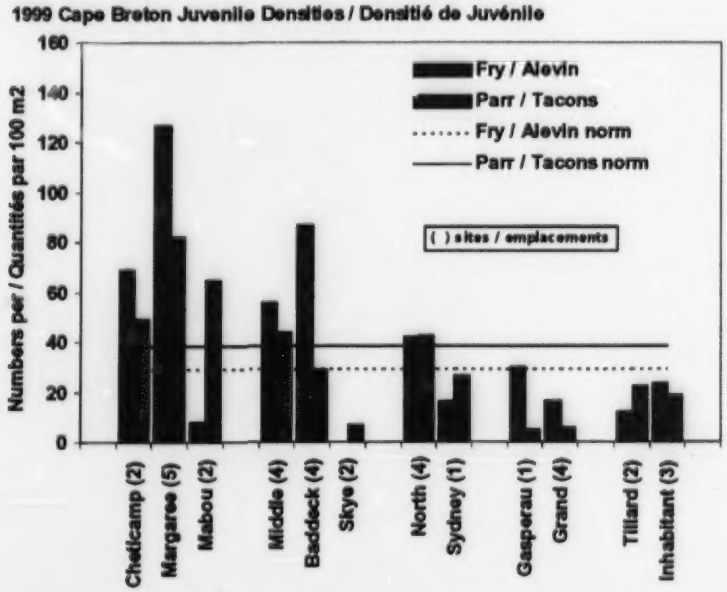
There is no precedent for forecasting returns to the Grand River. A forecast based on the mean of wild returns, 1995-1999, (the last stocking of hatchery fish i.e., 23,500 age-0^+ parr in 1996, is unlikely to contribute more than a few returns in 2000) is 113 fish (90% CL 34-198) comprised mostly of small salmon. Bayes procedures indicate a <1% probability that the conservation requirements of 234 fish could be met by wild returns in 2000. Recent low and declining parr densities are not suggestive of future increases in adult returns.

Fisheries Management Considerations

In the absence of any fishery, returns to the Grand River fishway met less than one-half the conservation requirement for the area upriver of the fishway. Returns to the area above the falls in 2000 will be dependent on wild production, and the probability of meeting fish conservation requirements is <1%.

Other Rivers of SFA 18 and SFA 19

In 1999, juvenile salmon surveys were again conducted on the Cheticamp and Mabou rivers in SFA 18 and Skye, Sydney, Gaspereaux, Tillard and Inhabitants rivers in SFA 19. Mean river densities (number of sites in brackets) of fry (age -0^+)and parr (age -1^+ and 2^+) for sites surveyed in 1999 relative to Elson (1967) norms are shown below. The paucity of sites on some rivers and the potential for fry to remain concentrated in areas proximate to egg deposition renders fry data less valuable than the usually more spatially distributed parr.



In general, estimated parr densities relative to norms and estimates of numbers of returning salmon and escapements among fully assessed stocks contribute to the following generalized *fishery management considerations*: (1) Stocks of SFA 18 Gulf Cape Breton may all be meeting and, with a high degree of probability, be expected to meet conservation requirements in 2000. (2) Stocks of the Bras d'Or Lakes have in general terms not met or have been borderline to conservation requirements and should not be expected to improve in 2000. Of special note is the Skye River where in 1998, 100 grilse-sized salmon were reported harvested by Aboriginal fishers (no report in 1999) at sites proximate to the river and where in 1999 the average density age-0^+ parr fell to 0.2

per 100 m^2. Fishing mortality on this stock, in particular, should as a precaution be minimized. (3) Stocks of Atlantic coast rivers exhibit, on average, lower parr densities than Gulf and Bras d'Or rivers (excluding Skye River). These parr densities indicate a need for caution and river specific assessments before more liberalized fishing is permitted.

Summary

Stocks of SFA 18 Cape Breton may all be surpassing conservation requirements. Exploitation levels both realized and potential have not been a conservation concern. Small salmon are predominantly male and generally are less abundant than large salmon. Returns in 2000 to the Margaree River are expected to be above conservation (96% chance). Directed fisheries within the limits of existing Aboriginal agreements would not be expected to jeopardize the attainment of conservation requirements. However, the estimated decline since 1997 in large salmon returns to the Margaree suggest that fishing mortality be better monitored and that as a precaution, in-season assessments be implemented prior to increases to fishing mortality from recent documented levels.

The status of stocks tributaries of the Bras d'Or Lakes (SFA 19) are generally not meeting conservation requirements. Small salmon are predominantly male and are less abundant than large salmon. Conservation requirements have generally not been met and expectations for 2000 are that returns will be below conservation. The Skye River is of particular concern. Fishing mortality should not be increased on Bras d'Or Lakes stocks and in the case of the Skye River, where fry and parr are seriously reduced, should as a precaution be minimized.

Stocks of Atlantic coast rivers (SFA 19) exhibit, on average, lower parr densities than Gulf and Bras d'Or, even though North River had, until perhaps this year, been exceeding conservation requirements. Juvenile densities for Sydney, Tillard and Inhabitants rivers suggests a group of Atlantic coast rivers whose status is no worse than those of Bras d'Or. With the exception of the Grand River, large salmon are dominant and small salmon are predominantly male. The returns to North River in 2000 should exceed conservation (88% chance) but full directed fisheries on small and large salmon could remove in excess of 15% (Marshall *et al.* MS 1999a) of the potential eggs on a stock that since 1997 may be in serious decline. Salmon from the Grand River are comprised primarily of small salmon with the few large salmon being repeat-spawning 1SW fish. The wild stock on which the river is now totally dependent has been declining since 1995, has not met conservation requirements since 1990 and is highly unlikely to meet conservation requirements in 2000. As a precaution it would be unwise to increase fishing mortality on Atlantic coast rivers without additional river-specific assessments.

Acknowledgements

Co-workers Peter Amiro, Shane O'Neil, Doug Shaw and R.C. Thompson, F&HMB in Sydney, and volunteers Leonard Forsyth, ADAM (Margaree), Margaree Valley and Jim

Eddington, Halifax, assisted in October/November dive counts. First Peoples from Wagmatcook First Nation and Parks Canada and Erland Hart, among others, assisted in electrofishing and Alex Pate maintained the fish trap at Grand River Falls.

Literature Cited

Amiro, P.G. and D.A. Longard. MS 1990. Status of Atlantic salmon stocks of the Grand River, Richmond Co., N.S. 1988. CAFSAC Res. Doc. 90/3, 18 p.

Amiro, P.G. and D.A. Longard. MS 1995. Status of Atlantic salmon stocks of Salmon Fishing Area 19, Eastern Cape Breton Island, 1994. DFO Atl. Fish. Res. Doc. 95/82. 35p.

Amiro, P.G. and C.J. Harvie. MS 1996. Assessment of risk to conservation for Atlantic salmon of North River, Victoria County, N.S. associated with uncertainty in escapement and harvests. Draft MS, Hfx. NS, np.

Elson, P.F. 1967. Effects on wild young salmon of spraying DDT over New Brunswick Forests. J. Fish. Res. Board 24 (4): 731-767.

Marshall, T.L., R. Jones, P. LeBlanc, and L Forsyth. MS 1996. Status of Atlantic salmon stocks of the Margaree and other selected rivers of Cape Breton Island, 1995. DFO Atl. Fish. Res. Doc. 96/142, 82 p.

Marshall, T.L., P. LeBlanc, K. Rutherford and R. Jones. MS 1998. Status of Atlantic salmon stocks of Cape Breton Island, 1997. DFO CSAS 98/31, iii + 49 p.

Marshall, T.L., G.J. Chaput, P.G. Amiro, D.K. Cairns, R.A. Jones, S.F. O'Neil, and J.A. Ritter. MS 1999a. Assessments of Atlantic salmon stocks of the Maritimes Region, 1998. DFO CSAS 99/25, 77 p.

Marshall, T.L., K. Rutherford, P. LeBlanc and R. Jones. MS 1999b. Follow-up to the assessment of Atlantic salmon in selected rivers of Cape Breton Island, 1998. DFO CSAS 99/108.

Paterson, W.D., C. Gallant, D. Desaultels and L. Marshall. 1979. Detection of bacterial kidney disease in wild salmonids in the Margaree river system and adjacent waters using an indirect fluorescent antibody technique. J. Fish. Res. Board Can. 36(12): 1464-1468.

Pol, R. MS 1975. Analysis of change in flow regime of the Northeast Margaree River Basin, Cape Breton Island, Nova Scotia. Water Resources Branch, Water Survey of Canada, Halifax. 40 p.

Table 1. Fisheries removals (number of fish) of Atlantic salmon from rivers of the Maritime Provinces 1995 to 1999. Removals refers to losses to spawning resulting from the fishing activity. For the recreational fisheries, the removals include losses estimated to have occurred as a result of hook-and-release induced mortality. 1999 data are provisional.

			Aboriginal Fisheries Removals										Recreational Fisheries Removals[1]									
			Small Salmon					Large Salmon					Small Salmon					Large Salmon				
River	SFA	Index	'95	'96	'97	'98	'99	'95	'96	'97	'98	'99	'95	'96	'97	'98	'99	'95	'96	'97	'98	'99
Margaree	18	22	2	7	20	30	8	4	89	124	120	45	206	306	204	213	253	53	93	105	66	46
Middle[2]	19	23	1	4	3	5	5	7	16	15	9	9	2	5	4	6	1	3	7	4	2	4
Baddeck	19	24	2	2	5	3	3	5	7	13	7	7	10	2	1	2	1	4	8	3	3	2
North	19	25	0	1	0	0	0	0	2	0	0	0	9	9	4	4	1	10	6	7	4	2
Grand	19	26	0	0	0	0	0	0	0	0	0	0	-	5	4	2	1	1	1	1	1	1

[1] "Closed" means no salmon fishing was allowed, "-" means no data were available, "0" means no removals occurred.
[2] Significant removals of "black" salmon in the winters of 1997-'98, and 1998-'99.

Table 2. Summary of stock status of Atlantic salmon in selected rivers of Cape Breton Island, Nova Scotia. All 1999 information is provisional.

River	SFA	Method	Map Index	Returns in 1999 Small	Returns in 1999 Large	% hatchery origin	Conservation met 1999	Conservation met 1984 - 1999	Qualitative estimate of abundance Juveniles	Adults Wild	Adults Hatchery	Status in 1999 rel. to 1998	Status in 1999 1984 to 1998	Constraints
Margaree	18	Ang	22	820	2060	5 to 10%	Yes	15 of 15	High ⇔	High ⇔	Low ⇔	U	U	
Middle	19	ViM	23	90	360	0%	No	2 of 11	High ⇔	Low ⇔	Na	⇧	U	
Baddeck	19	-	24	-	-	0%	Unlikely	0 of 6	High ⇔	Low ⇔	Na			
North	19	Ang	25	58	120	0%	Likely	14 of 15	Med ⇔	Low U	Na	U	U	
Grand	19	Fw	26	105	5	34%	No	7 of 12	Low ⇔	Low U	Med U	U	U	Fp

Assessment methods: Ang = angling catches and assumed exploitation rates; CR = catch rate index; Electro. = Index of abundance, juveniles and adults.
Fe = counting fence; Fw = fishway; MR = mark and recapture experiment
Sh = shore count; Vi = snorkel count; ViM = snorkel count and mark/recapture calibration
Map index numbers refer to text figure and legend.

Trend symbols (over recent ten years): U = decline; ⇔ = no change; ⇧ = increase (Low, Med & High = qualitative)

Potential constraints to production: Ac = acid impacted rivers; Aq = aquaculutre escapees
Fp = fish passage constraints; LU = land use practices; WU = water use practices

Appendix 1. Recreational catch and effort for Atlantic salmon on rivers of Cape Breton Island, 1999.

PRELIMINARY

River		Season dates			Observed	Numbers caught (including releases)						Effort		Catch per	Percent
		Begin		End	No. of	Grilse		Salmon		Total		No. of rod days		effort	large
Code	Name	D	M	D M	anglers	Obs.	Est.	Obs.	Est.	Obs.	Est.	Obs.	Est.	Fish/day	salmon
1	Aconi Brook	1/06		31/10 *	0										
4	Baddeck	1/06		31/10 *	49	5	11	36	81	41	92	110	246	0.373	87.8
5	Barachois	1/06		31/10 *	5	4	9	1	2	5	11	6	13	0.833	20.0
134	Campbell's Brook	1/09		31/11	1	1	2	0	0	1	2	1	2	1.000	0.0
11	Catalone	1/06		31/10 *	0										
12	Cheticamp	16/05		30/09	2	2	4	0	0	2	4	12	27	0.167	0.0
124	Clyburne	1/06		31/10 *	1	0	0	0	0	0	0	2	4	0.000	0.0
28	Framboise	1/06		31/10 *	2	0	0	0	0	0	0	3	7	0.000	0.0
30	Gaspereaux: C. Breton	1/06		31/10 *	1	0	0	0	0	0	0	1	2	0.000	0.0
34	Gerratt	1/06		31/10 *	0										
36	Grand	1/06		31/10 *	4	11	25	3	7	14	31	21	47	0.667	21.4
135	Grantmire Brook	1/06		31/10 *	3	4	9	10	22	14	31	10	22	1.400	71.4
41	Indian Brook	1/06		31/10 *	3	1	2	0	0	1	2	4	9	0.250	0.0
42	Ingonish	1/06		31/10 *	1	0	0	1	2	1	2	4	9	0.250	100.0
44	Inhabitants	1/06		31/10 *	1	0	0	0	0	0	0	2	4	0.000	0.0
127	Little Lorraine	1/06		31/10 *	0										
56	Lorraine Brook	1/06		31/10 *	0										
119	Mabou	1/09		31/10	2	3	7	4	9	7	16	8	18	0.875	57.1
133	MacAskill's Brook	1/06		31/10 *	0										
59	Margaree	1/06		31/10 *	510	168	376	414	927	582	1303	3332	7461	0.175	71.1
60	Marie Joseph	1/06		31/10 *	1	0	0	0	0	0	0	1	2	0.000	0.0
66	Middle: Victoria Co.	1/06		31/10 *	83	18	40	60	134	78	175	191	428	0.408	76.9
67	Mira	1/06		31/10 *	2	0	0	0	0	0	0	3	7	0.000	0.0
139	Mull	1/09		31/10	1	0	0	0	0	0	0	1	2	0.000	0.0
77	North : Victoria Co.	1/06		31/10 *	33	13	29	27	60	40	90	138	309	0.290	67.5
78	North Aspy	1/06		31/10 *	4	1	2	2	4	3	7	12	27	0.250	66.7
120	Northwest Brook (River Ryan)	1/06		31/10 *	0										
129	River Bennett	1/06		31/10 *	1	1	2	0	0	1	2	10	22	0.100	0.0
122	River Deny's	1/09		31/10	0										
89	River Tillard	1/06		31/10 *	0										
93	Saint Esprit	1/06		31/10 *	0										
97	Salmon: Cape Breton	1/06		31/10 *	6	1	2	4	9	5	11	12	27	0.417	80.0
123	Skye	1/09		31/10	0										
125	Sydney	1/06		31/10 *	0										
Cape Breton totals					716	233	520	562	1257	795	1779	3884	8695	0.205	70.7

Appendix II. Recreational catch and effort for Atlantic salmon on rivers of Cape Breton Island, 1999 Preliminary 1998 and 1994-1998.

	1999 Preliminary				1998				1994 - 1998 means							
	Grilse		Salmon		Grilse		Salmon		Grilse				Salmon		Effort	
River	retained	released	released	Effort	retained	released	released	Effort	retained	95% C.I.	released	95% C.I.	released	95% C.I.	roddays	95% C.I.
Cape Breton																
Aconi Brook									0	N/A	0	N/A	0	N/A	0	N/A
Baddeck	0	11	81	246	0	61	86	316	2	3.8	38	26.9	90	53.6	298	102.9
Barachois	0	9	2	13	1	7	1	37	0	0.6	6	4.6	13	10.9	47	12.9
Campbell's Brook	0	2	0	2					0	N/A	0	N/A	0	N/A	0	N/A
Catalone					0	1	0	3	0	0.0	2	5.4	1	3.9	13	24.0
Cheticamp	0	4	0	27	0	4	19	50	0	0.0	10	7.6	26	17.4	86	35.0
Clyburne	0	0	0	4	0	0	1	8	0	0.0	1	1.0	10	21.2	19	28.4
Framboise	0	0	0	7	0	0	0	16	0	0.0	1	2.0	0	0.6	30	24.6
Gaspereaux: Cape Breton Co.	0	0	0	2	0	9	1	45	0	0.0	2	6.2	5	7.2	27	19.2
Gerratt									0	N/A	0	N/A	0	N/A	3	N/A
Grand	0	25	7	47	0	57	21	222	1	2.1	62	37.0	18	12.2	222	173.0
Grantmire Brook	0	9	22	22	0	1	1	7	0	N/A	3	N/A	5	N/A	12	N/A
Indian Brook	0	2	0	9	0	4	1	26	0	0.0	2	2.5	2	2.3	20	8.6
Ingonish	0	0	2	9	0	3	9	11	0	0.0	4	1.4	8	2.0	39	36.5
Inhabitants	0	0	0	4	0	9	15	37	0	1.1	12	11.7	35	37.1	73	74.6
Little Lorraine									0	N/A	0	N/A	0	N/A	0	N/A
Lorraine Brook									0	N/A	0	N/A	0	N/A	0	N/A
Mabou	7	0	9	18	3	0	4	19	3	3.4	0	0.7	3	3.1	18	11.2
MacAskill's Brook									0	N/A	0	N/A	0	N/A	0	N/A
Margaree	246	130	927	7461	206	143	1327	10286	234	56.0	290	436.0	1566	516.6	10772	2482.4
Marie Joseph	0	0	0	2	0	0	0	0	0	N/A	1	N/A	6	N/A	32	N/A
Middle: Victoria Co.	0	40	134	428	5	27	62	314	2	2.6	33	21.4	100	63.3	355	177.9
Mira	0	0	0	7	0	3	9	57	0	0.0	4	5.5	3	4.8	36	38.0
Mull	0	0	0	2	0	0	0	0	0	N/A	0	N/A	0	N/A		N/A
North: Victoria Co.	0	29	60	309	0	113	109	447	0	0.7	119	62.0	135	54.5	455	122.9
North Aspy	0	2	4	27	0	3	8	23	0	0.0	5	5.5	19	16.8	38	29.2
Northwest Brook (River Ryan)									0	N/A	0	N/A	0	N/A	0	N/A
River Bennett	0	2	0	22					0	N/A	0	N/A	0	N/A	0	N/A
River Deny's									0	N/A	0	N/A	0	N/A	1	N/A
River Tillard					0	0	0	12	0	0.0	4	6.2	4	9.7	12	10.5
Saint Esprit									0	N/A	0	N/A	0	N/A	64	N/A
Salmon: Cape Breton Co.	0	2	9	27	0	8	9	123	0	0.6	7	7.7	12	15.7	90	68.1
Skye					0	0	0	4	0	N/A	0	N/A	0	N/A	4	N/A
Sydney					0	0	0	3	0	0.0	1	2.8	0	0.6	11	23.3
Totals	253	267	1257	8695	215	453	1683	12066	242		605		2059		12779	

Appendix III. Annual summaries of catch, effort and estimated 1SW fish retained from NS license stub returns for assessed rivers of Cape Breton, 1984-99. Mean = 1994 to 1998). The 1999 data are preliminary. (Unk. Obs. are undefined small/large)

Year	River	No. Angler	Small Obs.	Small Est.	Est. Ret.	Large Obs.	Large Est.	Unk. Obs.	Total Obs.	Total Est.	Roddays Obs.	Roddays Est.	CPUE	% Large
	Baddeck													
1984		60	6	6	4	42	45	0	48	51	254	284	0.189	87.5
1985		34	4	5	4	12	14	0	16	19	94	100	0.170	75.0
1986		68	25	26	20	133	139	0	158	165	364	383	0.434	84.2
1987		90	40	40	26	126	126	0	166	166	411	435	0.404	75.9
1988		86	31	36	19	149	175	0	180	211	366	444	0.492	82.8
1989		98	15	18	8	204	247	0	219	265	392	490	0.559	93.2
1990		103	56	71	40	144	182	0	200	253	445	580	0.449	72.0
1991		110	40	51	28	166	213	0	206	264	483	640	0.427	80.6
1992		129	45	57	50	131	165	0	176	221	538	698	0.327	74.4
1993		146	45	48	33	101	108	0	146	156	689	785	0.212	69.2
1994		74	13	16	1	50	62	0	63	78	238	305	0.265	79.4
1995		61	49	61	7	57	71	0	106	131	263	336	0.403	53.8
1996		70	37	46	0	133	165	0	170	211	293	374	0.580	78.2
1997		42	11	15	0	48	64	0	59	79	115	157	0.513	81.4
1998		87	46	61	0	65	86	0	111	147	232	316	0.478	58.6
1999		49	5	11	0	36	81	0	41	92	110	246	0.373	87.8
	+/- 1998	-44%	-89%	-82%	-	-45%	-6%	-	-63%	-37%	-53%	-22%	-22%	50%
	+/- Mean	-27%	-84%	-72%	-100%	-49%	-10%	-	-60%	-29%	-52%	-17%	-17%	25%
	Grand													
1984		268	367	393	338	32	34	11	410	438	2,777	3,110	0.148	8.0
1985		312	520	542	471	127	132	1	648	675	2,896	3,094	0.224	19.6
1986		326	336	360	298	181	194	0	517	554	2,865	3,015	0.180	35.0
1987		262	311	342	308	97	107	0	408	449	1,961	2,077	0.208	23.8
1988		277	276	324	303	86	101	0	362	425	2,731	3,311	0.133	23.8
1989		247	258	312	290	62	75	0	320	387	2,167	2,707	0.148	19.4
1990		240	327	413	335	80	101	0	407	514	2,192	2,858	0.186	19.7
1991		178	100	128	115	14	18	0	114	146	1,499	1,985	0.076	12.3
1992		182	127	160	148	35	44	0	162	204	1,483	1,925	0.109	21.6
1993		184	117	139	118	21	25	0	138	164	1,311	1,494	0.105	15.2
1994		44	58	72	0	16	20	0	74	92	321	411	0.231	21.6
1995		4	4	5	0	10	12	0	14	17	38	49	0.368	71.4
1996		26	72	90	0	20	25	0	92	115	227	290	0.405	21.7
1997		21	22	29	3	4	5	0	26	34	99	136	0.263	15.4
1998		20	43	57	0	16	21	0	59	78	163	222	0.362	27.1
1999		4	11	25	0	3	7	0	14	32	21	47	0.667	21.4
	+/- 1998	-80%	-74%	-56%	-	-81%	-67%	-	-76%	-59%	-87%	-79%	84%	-21%
	+/- Mean	-83%	-72%	-51%	-100%	-77%	-58%	-	-74%	-52%	-88%	-79%	105%	-32%
	Margaree													
1984		678	233	242	190	293	305	4	530	551	5,952	6,665	0.089	55.7
1985		793	473	509	399	1,130	1,215	3	1,606	1,727	7,324	7,824	0.219	70.4
1986		1,131	748	782	650	2,522	2,636	2	3,272	3,420	9,724	10,232	0.336	77.1
1987		1,441	925	977	826	1,757	1,857	0	2,682	2,834	12,165	12,887	0.220	65.5
1988		1,455	749	879	752	1,647	1,932	0	2,396	2,810	11,582	14,042	0.207	68.7
1989		1,486	464	561	434	1,298	1,570	0	1,762	2,132	10,594	13,234	0.166	73.7
1990		1,383	514	649	498	1,193	1,507	0	1,707	2,156	10,792	14,073	0.158	69.9
1991		1,236	586	752	559	1,370	1,757	0	1,956	2,509	10,142	13,432	0.193	70.0
1992		1,426	539	678	551	1,541	1,938	0	2,080	2,616	11,483	14,909	0.181	74.1
1993		1,885	696	777	562	987	1,102	0	1,683	1,879	13,920	15,863	0.121	58.6
1994		1,382	346	429	291	1,193	1,479	0	1,539	1,908	10,452	13,376	0.147	77.5
1995		1,268	269	333	199	856	1,060	0	1,125	1,393	9,617	12,293	0.117	76.1
1996		986	738	918	274	1,499	1,864	0	2,237	2,782	7,119	9,096	0.345	61.0
1997		1,158	237	316	198	1,575	2,098	0	1,812	2,413	6,436	8,809	0.282	86.9
1998		1,073	263	349	206	1,000	1,327	0	1,263	1,675	7,543	10,286	0.167	79.2
1999		510	168	376	246	414	927	0	582	1,302	3,332	7,461	0.175	71.1
	+/- 1998	-52%	-36%	8%	19%	-59%	-30%	-	-54%	-22%	-56%	-27%	5%	-10%
	+/- Mean	-57%	-55%	-20%	5%	-66%	-41%	-	-64%	-36%	-60%	-31%	-17%	-7%

Appendix III. Annual summaries of catch, effort and estimated 1SW fish retained from NS license stub returns for assessed rivers of Cape Breton, 1984-99. Mean = 1994 to 1998). The 1999 data are preliminary. (Unk. Obs. are undefined small/large)

	Middle													
1984		83	29	33	21	66	75	0	95	108	470	526	0.202	69.5
1985		39	18	21	15	24	29	0	42	50	150	160	0.280	57.1
1986		76	44	44	36	107	108	0	151	152	368	387	0.410	70.9
1987		114	55	58	53	111	116	0	166	174	684	725	0.243	66.9
1988		131	42	49	36	121	142	0	163	191	591	717	0.276	74.2
1989		144	43	52	41	231	279	0	274	332	694	867	0.395	84.3
1990		153	85	107	80	156	197	0	241	304	771	1005	0.313	64.7
1991		169	21	27	18	145	186	0	166	213	646	856	0.257	87.3
1992		66	9	11	8	24	30	0	33	41	167	217	0.198	72.7
1993		110	28	30	25	44	48	0	72	78	356	406	0.202	61.1
1994		122	19	24	0	134	166	0	153	190	389	498	0.393	87.6
1995		72	30	37	0	41	51	0	71	88	224	286	0.317	57.7
1996		125	48	60	2	114	142	0	182	202	395	505	0.415	69.5
1997		52	13	17	3	59	79	0	72	98	127	174	0.567	81.9
1998		99	24	32	5	47	62	0	71	94	230	314	0.309	66.2
1999		83	18	40	0	60	134	0	78	174	191	428	0.408	76.9
	+/- 1998	-16%	-25%	25%	-100%	28%	116%	-	10%	85%	-17%	36%	32%	16%
	+/- Mean	-12%	-33%	18%	-100%	-24%	34%	-	-26%	30%	-30%	20%	2%	6%
	North													
1984		162	60	65	56	139	151	1	200	217	1,091	1,222	0.183	69.8
1985		170	146	162	149	383	426	0	529	588	947	1,012	0.559	72.4
1986		298	235	235	185	1,010	1,010	0	1,245	1,245	1,945	2,047	0.640	81.1
1987		263	219	226	177	529	548	0	748	772	1,574	1,667	0.475	70.7
1988		202	115	135	118	456	535	0	571	670	1,305	1,582	0.438	79.9
1989		162	134	162	122	331	400	0	485	563	1,074	1,342	0.433	71.2
1990		219	212	268	202	483	610	0	695	878	1,416	1,846	0.491	69.5
1991		172	145	186	148	277	355	0	422	541	1,050	1,391	0.402	65.6
1992		205	178	224	184	437	550	0	615	773	1,421	1,845	0.433	71.1
1993		217	72	82	62	142	161	0	214	243	1,094	1,247	0.196	66.4
1994		73	60	74	0	78	97	0	138	171	317	406	0.435	56.5
1995		77	136	168	1	169	209	0	305	378	402	514	0.759	55.4
1996		81	140	174	0	100	124	0	240	298	457	584	0.525	41.7
1997		57	52	69	1	101	135	0	153	204	238	326	0.643	66.0
1998		84	85	113	0	82	109	0	167	222	328	447	0.509	49.1
1999		33	13	29	0	27	60	0	40	89	138	309	0.250	66.7
	+/- 1998	-61%	-85%	-74%	-	-67%	-45%	-	-76%	-60%	-58%	-31%	-51%	36%
	+/- Mean	-56%	-86%	-76%	-100%	-75%	-55%	-	-80%	-65%	-60%	-32%	-56%	24%

Appendix IV. Results of electrofishing surveys at barrier net sites in Cape Breton Island, 1995-1999.

River	Site Name	Area m2	No. of sweeps	Age 0+ Catch	Age 0+ Est. Pop'n	Age 0+ Density 100m²	Age 1+, 2+ Catch	Age 1+, 2+ Est. Pop'n	Age 1+, 2+ Density 100 m²
1999									
Middle	Main, Finlayson	545	4	101	105	19.2	226	248	45.5
	Main, Twin Churches*	326	3	203	206	63.3	94	101	30.9
	Main, 2nd Gold Brook	356	4	268	284	79.7	152	155	43.5
	MacKenzie Bk	99	4	53	59	59.2	46	55	55.2
	Mean, 3 main river sites					54.1			40.0
Baddeck	Upper, Site #2 (main)	465	3	73	77	16.5	121	127	27.4
	N Br, Site #3 (main)	599	4	997	1025	171.1	112	120	20.0
	N Br, Site #4 (main)	382	4	355	374	98.0	183	193	50.6
	Peter's Bk, SP#5	300	3	165	181	60.3	50	52	17.4
	Mean, 3 main river sites					95.2			32.6
North	Main, Karr's	340	3	148	154	45.3	51	57	16.9
	Main, Narrows	388	3	50	51	13.2	134	136	35.2
	Main, MacLeans	443	4	250	258	58.3	365	382	86.2
	Main Benches	324	4	146	160	49.5	95	97	30.0
	Mean, 4 main river sites					41.6			42.1
Cheticamp	Robert's Brook	493	3	514	524	106.2	204	208	42.3
	Main (Above Fairbault Bk)	302	4	92	92	30.6	162	168	55.6
Skye	Main	245	3	1	.	0.4	12	15	6.2
	Mullach Brook	167	3	0	.		10	11	6.5
Mabou	Mull River	190	3	6	8	4.0	156	168	88.4
	Mabou (MacLeod Brook)	298	3	29	34	11.2	108	120	40.3
Inhabitants	Main	361	4	61	62	17.1	81	85	23.6
	Lamey Brook	410	3	170	199	48.6	58	67	16.4
	Northwest Arm	330	3	10	13	4.0	36	50	15.1
1998									
Middle	Main, Finlayson	556	4	113	119	21.5	253	270	48.5
	Main, Twin Churches*	369	4	134	135	36.7	196	201	54.7
	MacLeods Bk	132	4	21	24	17.8	44	46	35.0
	MacKenzie Bk	101	3	9	10	9.5	48	49	48.9
	Mean, 2 main river sites					29.1			51.6
Baddeck	Upper, Site #2	456	4	196	208	45.7	149	153	33.5
	N Br, Site #3	515	3	227	234	45.5	95	101	19.6
	N Br, Site #4	419	3	388	431	102.8	141	156	37.2
	Peter's Bk, SP#5	217	3	133	139	64.0	55	57	26.3
	Mean, 3 main river sites					64.7			30.1
North	Main, Karr's	444	3	51	55	12.4	61	66	14.9
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6.7	72	78	19.3
	Mean, 2 riverine sites					9.6			17.1
Cheticamp	Robert's Brook	408	3	267	272	66.8	154	159	39.0
	Main (Above Fairbault Bk)	400	4	282	285	71.1	184	188	47.0
Skye	Main	306	3	2	.	0.7	42	51	16.8
	MacDonald Brook	132	3	0	.	.	17	20	14.9
	Mullach Brook	256	3	23	24	9.5	10	10	4.1

Appendix IV. Results of electrofishing surveys at barrier net sites in Cape Breton Island, 1995-1999.

River	Site Name	Area m2	No. of sweeps	Age 0+ Catch	Age 0+ Est. Pop'n	Age 0+ Density 100m²	Age 1+, 2+ Catch	Age 1+, 2+ Est. Pop'n	Age 1+, 2+ Density 100 m²
Mabou	Mull River	218	3	132	148	67.7	148	153	70.2
	MacLeod Brook	315	3	74	75	23.9	118	125	39.6
Inhabitants	Main	385	3	75	82	21.3	138	140	36.4
	Lamey Brook	527	3	23	25	4.7	158	181	30.6
	Northwest Arm	358	3	85	89	24.8	27	28	7.7
1997									
Middle	Main, Finlayson	533	3	147	152	28.6	330	353	66.3
	Main, Twin Churches*	364	4	153	159	43.6	91	92	25.1
	MacLeods Bk	260	4	165	167	64.1	143	156	60.1
	MacKenzie Bk	122	4	0	0	0.0	148	152	124.2
	Mean, 2 main river sites					36.1			45.7
Baddeck	Upper, Site #2	397	4	190	200	50.3	162	169	42.5
	N Br, Site #3	457	3	774	819	179.2	97	116	25.3
	N Br, Site #4	372	4	401	412	110.7	165	180	48.3
	Peter's Bk, SP#5	181	4	187	190	118.2	56	58	35.8
	Mean, 3 main river sites					113.4			36.7
North	Abv Church Pl (tidal infl.)	414	3	6	6+	1.5+	1	1+	<1
	Main, MacDonalds	430	3	23	24	5.6	134	142	33.1
	MacLeans	352	3	121	314	89.4	119	137	38.9
	Benches	350	3	53	57	16.4	83	87	24.9
	Mean, 3 riverine sites					37.1			32.3
Skye	Main	201	3	39	41	20.5	23	25	12.6
	MacDonald's Brook	133	3	20	21	16.1	2	.	1.5
Mabou	Mull River	167	4	238	252	150.9	140	151	90.5
	MacLeod Brook	301	4	596	624	207.3	109	134	44.5
1998									
Middle	Main, Finlayson	530	4	194	196	36.9	279	287	54.2
	Main, Two Churches	333	3	72	82	24.7	110	120	36.0
	MacLeods Bk	224	4	55	56	24.8	138	147	65.8
	MacKenzie Bk	103	4	175	176	171.0	64	67	64.6
	Mean, 2 main river sites					30.8			45.1
Baddeck	Main, Glenhaven	368	4	226	254	69.1	148	153	41.7
	N. Br, Picnic Pk	491	4	261	281	57.3	87	99	20.1
	N. Br, Bridge	378	4	235	240	63.6	168	174	46.1
	Peter's Bk	168	4	248	253	150.1	39	39	23.2*
	Mean, 3 main river sites					63.3			36.0
North	Main, MacDonalds	408	3	40	41	10.1	114	121	29.8
	Main, Church	357	3	116	118	33.0	49	51	14.3
	Mean, 2 main river sites					21.6			22.1
1999									
Middle	Main, Hwy 19	181	4	191	197	108.9	59	62	34.3
	Main, ab Gold Bk	251	3	281	287	106.3	43	46	18.3
	MacKenzie Bk	95	4	159	174	174.1	63	72	75.8
	Mean, 2 main river sites					107.6			26.3

*Minimum based on total catch, variance of estimate was negative.

Note: Skye main site 1998 and 1999 estimate based on total catch/site area.

Note: MacLeod Brook (Middle River) 1998 variances unreliable because N< 50

Note: Mullach Brook site has several beaver dams below, may account for 0 fry during 1999.

Appendix V. Summary of effort, catch and CPUE from logbook anglers on Margaree River, 1991 to 1999.

Year	Season	Month	Angler Days	Small		Large		Total	
				Catch	CPUE	Catch	CPUE	Catch	CPUE
1991									
	Summer	June	60	0	0.000	3	0.050	3	0.050
		July	101	9	0.089	10	0.099	19	0.188
		August	186	16	0.086	32	0.172	48	0.258
	Sub-Total		347	25	0.072	45	0.130	70	0.202
	Fall	September	222	24	0.108	76	0.342	100	0.450
		Oct. 1-15	176	7	0.040	63	0.358	70	0.398
		Oct. 16-31	43	4	0.093	19	0.442	23	0.535
		Oct. 1-31	219	11	0.050	82	0.374	93	0.425
	Sub-Total		441	35	0.079	158	0.358	193	0.438
	Total Season		788	60	0.076	203	0.258	263	0.334
1992									
	Summer	June	117	6	0.051	3	0.026	9	0.077
		July	185	28	0.151	40	0.216	68	0.368
		August	162	10	0.062	20	0.123	30	0.185
	Sub-Total		464	44	0.095	63	0.136	107	0.231
	Fall	September	176	12	0.068	26	0.148	38	0.216
		Oct. 1-15	211	18	0.085	66	0.313	84	0.398
		Oct. 16-31	74	5	0.068	49	0.662	54	0.730
		Oct. 1-31	285	23	0.081	115	0.404	138	0.484
	Sub-Total		461	35	0.076	141	0.306	176	0.382
	Total Season		925	79	0.085	204	0.221	283	0.306
1993									
	Summer	June	134	2	0.015	2	0.015	4	0.030
		July	204	16	0.078	12	0.059	28	0.137
		August	157	29	0.185	16	0.102	45	0.287
	Sub-Total		495	47	0.095	30	0.061	77	0.156
	Fall	September	193	6	0.031	18	0.093	24	0.124
		Oct. 1-15	154	6	0.039	26	0.169	32	0.208
		Oct. 16-31	41	4	0.098	8	0.195	12	0.293
		Oct. 1-31	195	10	0.051	34	0.174	44	0.226
	Sub-Total		388	16	0.041	52	0.134	68	0.175
	Total Season		883	63	0.071	82	0.093	145	0.164

Appendix V. Summary of effort, catch and CPUE from logbook anglers on Margaree River, 1991 to 1999.

Year	Season	Month	Angler Days	Small		Large		Total	
				Catch	CPUE	Catch	CPUE	Catch	CPUE
1994									
	Summer	June	80	3	0.038	13	0.163	16	0.200
		July	71	1	0.014	3	0.042	4	0.056
		August	98	9	0.092	5	0.051	14	0.143
	Sub-Total		249	13	0.052	21	0.084	34	0.137
	Fall	September	141	4	0.028	34	0.241	38	0.270
		Oct. 1-15	136	5	0.037	56	0.412	61	0.449
		Oct. 16-31	79	1	0.013	27	0.342	28	0.354
		Oct. 1-31	215	6	0.028	83	0.386	89	0.414
	Sub-Total		356	10	0.028	117	0.329	127	0.357
	Total Season		605	23	0.038	138	0.228	161	0.266
1995									
	Summer	June	56	1	0.018	6	0.107	7	0.125
		July	90	2	0.022	12	0.133	14	0.156
		August	71	3	0.042	8	0.113	11	0.155
	Sub-Total		217	6	0.028	26	0.120	32	0.147
	Fall	September	150	4	0.027	23	0.153	27	0.180
		Oct. 1-15	129	8	0.062	26	0.202	34	0.264
		Oct. 16-31	98	1	0.010	19	0.194	20	0.204
		Oct. 1-31	227	9	0.040	45	0.198	54	0.238
	Sub-Total		377	13	0.034	68	0.180	81	0.215
	Total Season		594	19	0.032	94	0.158	113	0.190
1996									
	Summer	June	94	5	0.053	15	0.160	20	0.213
		July	225	62	0.276	41	0.182	103	0.458
		August	214	49	0.229	43	0.201	92	0.430
	Sub-Total		533	116	0.218	99	0.186	215	0.403
	Fall	September	319	62	0.194	82	0.257	144	0.451
		Oct. 1-15	339	34	0.100	107	0.316	141	0.416
		Oct. 16-31	155	8	0.052	34	0.219	42	0.271
		Oct. 1-31	494	42	0.085	141	0.285	183	0.370
	Sub-Total		813	104	0.128	223	0.274	327	0.402
	Total Season		1346	220	0.163	322	0.239	542	0.403

Appendix V. Summary of effort, catch and CPUE from logbook anglers on Margaree River, 1991 to 1999.

Year	Season	Month	Angler Days	Small		Large		Total	
				Catch	CPUE	Catch	CPUE	Catch	CPUE
1997									
	Summer	June	130	1	0.008	22	0.169	23	0.177
		July	164	8	0.049	18	0.110	26	0.159
		August	190	9	0.047	18	0.095	27	0.142
	Sub-Total		484	18	0.037	58	0.120	76	0.157
	Fall	September	318	11	0.035	141	0.443	152	0.478
		Oct. 1-15	240	2	0.008	87	0.363	89	0.371
		Oct. 16-31	115	1	0.009	31	0.270	32	0.278
		Oct. 1-31	355	3	0.008	118	0.332	121	0.341
	Sub-Total		673	14	0.021	259	0.385	273	0.406
	Total Season		1157	32	0.028	317	0.274	349	0.302
1998									
	Summer	June	117	0	0.000	5	0.043	5	0.043
		July	198	14	0.071	27	0.136	41	0.207
		August	117	11	0.094	8	0.068	19	0.162
	Sub-Total		432	25	0.058	40	0.093	65	0.150
	Fall	September	247	14	0.057	47	0.190	61	0.247
		Oct. 1-15	200	5	0.025	36	0.180	41	0.205
		Oct. 16-31	121	1	0.008	28	0.231	29	0.240
		Oct. 1-31	321	6	0.019	64	0.199	70	0.218
	Sub-Total		568	20	0.035	111	0.195	131	0.231
	Total Season		1000	45	0.045	151	0.151	196	0.196
1999									
	Summer	June	33	0	0.000	0	0.000	0	0.000
		July	135	11	0.081	3	0.022	14	0.104
		August	131	8	0.061	7	0.053	15	0.115
	Sub-Total		299	19	0.064	10	0.033	29	0.097
	Fall	September	177	9	0.051	23	0.130	32	0.181
		Oct. 1-15	182	1	0.005	20	0.110	21	0.115
		Oct. 16-31	94	2	0.021	9	0.096	11	0.117
		Oct. 1-31	276	3	0.011	29	0.105	32	0.116
	Sub-Total		453	12	0.026	52	0.115	64	0.141
	Total Season		752	31	0.041	62	0.082	93	0.124